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SCIENCE

NEW YORK, OCTOBER 21, 1892.

THE CAUSES OF INFECTIOUS DISEASES.

BY HUGO ENGEL, A.M., M.D., FELLOW OF THE AMERICAN ACADEMY OF MEDICINE, L. PROFESSOR OF NERVOUS DISEASES AND CLINICAL MEDICINE AT PHILADELPHIA, ETC.

THE real causes producing infectious diseases were unknown until the present era. Preventive treatment, where it existed, was based upon empirical observations; and, although the idea of a *contagium vivum* was conceived a hundred years ago, the possibility of a tangible demonstration of the destructive agent underlying all those zymotic diseases which have so often decimated mankind and wiped whole communities from the face of the earth was scarcely dreamed of a few decades since.

To-day medicine may truthfully be called the benefactrix of the human race; and, though we are but on the threshold of the new era, yet enough has been already achieved to prove of eminent value to humanity. Only twenty years ago who would have thought it possible that so dreaded an epidemic as the Asiatic cholera could be prevented from entering a country whose borders it had reached, and that the fatal malady when it had once found victims in a populous city could be limited to the imported cases attacked, and its further progress be halted? Here we had cholera at our very doors; but it could not enter, and a whole continent has escaped its deadly visit. In such great centres of human industry as New York and Berlin, where thousands of strangers daily arrive and depart, a few cases occurred, but the ghastly disease was driven off without its being able to select one more victim!

Such facts prove the value of the achievements of modern medicine, and clearly show the immense progress this science has made. The question naturally occurs to the intelligent mind — how was it possible to achieve what but recently has seemed unattainable? And the answer is — because of the knowledge gained by bacteriology, this new but all-important branch of modern pathology!

Let us glance at the recent discoveries and bring before our mental eye the principles underlying the study of infectious diseases. At the boundary of the animal and vegetable kingdoms there is an immense empire of beings so minute that the naked eye cannot see them, and that the most powerful microscope alone does not suffice to determine the various species. So difficult becomes here the recognition of the individual that for years the most eminent authorities were in doubt how to classify these minute organisms. Are they animals or plants? The weight of testimony has at last decided in favor of the empire of plants. To it belong these micro-organisms, of which millions weigh but one grain, but which have the power of multiplying at such an extraordinary degree that, as Cohnheim has calculated, the breed of bacteria springing from one germ about $\frac{1}{500}$ of a millimeter in length and $\frac{1}{1000}$ of a millimeter in thickness, provided the development and multiplication could go on without hindrance, within less than five days would completely fill all the oceans of the earth, and the descendants of one single micrococcus, whose weight is so little that sixteen hundred millions of them weigh but one grain, would within three days reach the enormous weight of fifteen million pounds! But fortunately nature has placed impediments in their way; they can develop only under certain favorable conditions, otherwise how soon would these diminutive little beings overpower every living organism!

There are two great subdivisions of these microbes, hyphomyceti and schizomyceti. The first, so-called moulds or fungi, multiplying mainly by the aid of spores, are parasites, among which are many that give rise to diseases of the skin and mucous membrane, as favus, thrush, etc. The propagation of the second class — schizomyceti — takes place mainly by division. Most of them have a rod-like form. The Greek word for rod is βακτήριον; hence the term bacterium. But not all have the same shape, and according to their forms they are arranged in six classes: —

1. Micrococci, or cocci, with circular shape.
2. Bacilli, including all rod-shaped bacteria, short or long.
3. Bacteria proper, as which science recognizes only the shortest bacilli.
4. Vibriones, rods of wavy shape.
5. Spirilli, forming short, stiff screws.
6. Spirochaeti, having the form of long, flexible screws.

Modern research with positive certainty has demonstrated the fact that the activity of bacteria is not limited to the production of one kind of processes. While many of them never prey upon the human organism, others are pathogenic, i.e., disease producing; but the first condition necessary to their development is their entrance into the living human or animal body. One class of schizomyceti, the so-called septic bacteria, at once begin their enormous propagation, when death has interrupted the mechanism of life and the organized tissue having ceased all motion is decomposed, decays, ferments, and putrefies. To-day it is a recognized fact, undisputed by any authority, that the process of putrefaction by which the dead organized tissue returns its constituent parts to the inorganic world and thus completes the never-ending circle, is caused by the septic microbes alone. Without them there can be no decay. All our disinfectants, our processes of embalming, our methods of preserving organic substances by complete exclusion of air, are based upon one principle — preventing the development of septic bacteria.

Another kind of these minute organisms gives rise to various chemical changes known as fermentations. The process by which sugar is changed to alcohol and carbonic acid is due to the yeast-plant; when fermented fluids become acid, this change to the vinegar fermentation is caused by another bacterium; that milk turns sour a rod-shaped schizomycete is responsible for; the discolorations noticed on potatoes, cheese, boiled eggs, etc., as well as the blueish and yellowish tint sometimes assumed by milk, and the green and blue color of pus, are produced by bacteria. The remarkable incident which has caused so much religious superstition, viz., that on the holy wafer appeared a drop of blood, simply depends upon decomposition induced by a micrococcus (*Monades prodigiosæ*, Ehrenberg), and is met with also in unleavened bread.

But bacteria do not cause only the decomposition of *dead* organic substances, they extend their fiendish power also to the destruction of the processes of life of the highest organized beings — the human race and the animals nearest to it.

It would lead me here too far to narrate how the discovery was made, and how by patient research and logical reasoning science has at last succeeded in determining the true cause of infectious disease. Suffice it to say that every zymotic malady — be it acute, like cholera, pneumonia, typhoid fever, small-pox, chicken-pox, scarlet-fever, measles, whooping-cough, yellow-fever, intermittent or remittent fever, cerebro-spinal fever, erysipelas, diphtheria, etc., or chronic, like tubercular consumption, cancer, chronic malaria, lupus, etc. — is due to some special micro-organism, which during the process of development and multiplication in the human (animal) tissues gives rise to the formation of ptomaines, — highly organized and most virulent poisons, — which in their turn produce the phenomena, the group of symptoms, that characterize an infectious disease. And the more active this process of development, the greater the number of the bacteria introduced into the living organism, the more favorable the soil presented to them, the more viru ent is the ptomaine, the

more overwhelming the effect! We thus have an explanation of the fact often observed that at the beginning of some epidemics, especially of such grave maladies as yellow-fever, typhus, Asiatic cholera, etc., the victims seized by them frequently die within less than an hour after the first symptom has indicated the outbreak of the disease.

How difficult, however, bacteriological investigations are may be judged from the following data. Some of the pathogenic bacteria resemble each other so greatly that the microscope alone, however powerful, does not suffice for their recognition. In such cases the suspicious microbes are exposed to the influence of various coloring processes; and, as each species evinces a behavior different from that of another variety, the result of the coloring tests often leads to the recognition of the species. But even that does not satisfy the modern bacteriologist. Pure-culture and experimental research must be added. After all the microbes present in a diseased tissue have been removed, they are spread over a layer of beef-tea gelatine, where their development is watched under the microscope. If there are several species — suppose three, though there may be many more — it is soon found that on three different spots of the gelatine certain changes are going on. While in one spot a peculiar excrescence has formed, in another a cup-shaped depression is noticed with the gelatine near it dried, and in the third the shape observed is still different and the gelatine surrounding this spot has become more fluid. From these various behaviors the expert can probably recognize which of the three species is the pathogenic one for which he is looking. Certainly in all these researches care must be taken that no other micro-organism can enter the receptacle in which the developments are progressing; and, as the atmosphere constantly contains many kinds of microbes, the reader may have some conception of the difficulties presenting themselves.

After the suspicious species has been recognized on the gelatine soil, a minute particle is taken from that particular spot, and carried to another culture-soil, which may again be some bouillon gelatine, or agar-agar, or a potatoe-skin, or blood-serum, or any similar substance. It may also be noted that the different species evince a natural preference for some soil, while they obtain only a stunted growth in others.

In all these processes every instrument used must be aseptic, i.e., free from bacteria. Under the precautions mentioned the development of the micro-organisms selected from the one spot and transferred to a special culture-soil is again carefully noted, and if the phenomena accompanying the multiplication and maturing in this pure culture correspond with those known as characteristic of the species in question — in the case of an unknown species these characteristics must first be elucidated by special observations — then the experimental stage is entered. A minute particle of the result of the last pure culture is introduced into some animal organism, and if there it gives rise to the lesions and symptoms of the same infectious disease as that in which the bacteria had first been met with, and if later the specific bacteria taken from the blood or tissues of the inoculated and infected animal again behave under pure culture as the original species did, the proof is considered final and complete, and the microbe in question is recognized as the pathogenic element of the particular infectious disease in which it was found.

To illustrate, the sputum of patients suffering from tubercular consumption contains other bacteria besides the tubercle bacilli — the real cause of the fatal malady. A microscopical examination even with the application of some color-tests, while for practical purposes easily concluded and sufficient, if necessary to be done with scientific exactness does not answer every demand; because the species causing glanders, the fatal disease of horses, that of tubercle, of anthrax, and of cholera, at some time or other, have nearly the same shape. One appears a little thicker, another more rounded at one point, a third slightly longer; but, if we remember their minute size, we may imagine how slight the difference must be when one is an immeasurable bit smaller or thicker. In this instance other color-tests aid the expert; for, while the bacilli of glanders take on the coloring without difficulty, those of tubercle and of anthrax have to be exposed to its influence a considerable time. Then the bacilli of anthrax, after the staining, easily yield the color to the influence of acids, but those of tubercle resist the action even of sulphuric acid, while the comma bacilli of cholera soon develop other peculiar characteristics.

Sputa containing the tubercle bacilli were dried, mixed with street-dirt, exposed for months to all kinds of weather, again dried, and finally used for the following purpose. Two small brick houses were erected in Paris some miles apart, and into each one dozen healthy rabbits — A and B — were placed, which all received the same food, water, treatment, and attention with this difference: into the building containing the rabbits A some of the sputum-dust referred to was thrown daily for a week by the aid of a pair of bellows, so as to mix with the air in the room. About six weeks later all these rabbits had died of galloping consumption, while the rabbits B remained in excellent health.

A bacteriological examination showed the presence of the tubercle bacilli in large numbers in the tissues of the dead rabbits. Some of these bacteria, taken for pure culture, were later again introduced into the tissues of other animals, and again caused the outbreak of consumption in them and their final death.

The specific microbes of a great number of infectious diseases have been discovered, while in others the investigations are still being carried on. For the purpose of diagnosis this discovery is of the utmost import, as the presence of the specific microbes in any disease at once determines the true nature of the latter. Then by a careful study of the conditions of development of these bacteria valuable information has been gained, which has proved useful for the purposes of prevention. Thus in consumption we know, if the sputa of tuberculous patients are destroyed, and if the milk and flesh of animals suspected to be afflicted with the disease are thoroughly boiled. that the danger of infection from them disappears. In the same way we have learned that the germs of cholera are not propagated by the atmosphere, but that they must be swallowed to penetrate into the intestines where alone they can mature, multiply, and produce the disease. The knowledge of these facts enables us to prevent the spreading of the epidemic.

A study of the behavior of the bacteria of decomposition has led to the application of modern asepsis in surgery. A wound that is thoroughly impregnated with a disinfectant, i.e., with a remedy which destroys all such microbes, need only be protected against further contamination to insure its healing by first intention, meaning without the development of pus. Many serious operations which were indicated and which would have saved life years ago, while not presenting in their execution special difficulties to the experienced surgeon, could not be performed because the immense pus-discharge which would have followed them would have proved exhausting, and have brought about the death of the patient. Thus it was with operations on large joints, with injuries affecting the abdominal organs, and with lesions of some of the serous membranes, as the pleura, etc. To-day these operations are performed under the strictest aseptic precautions; the hands of the operator and those of his assistants, every instrument and appliance to be used, the external surface above the seat of the parts to be operated upon — all are disinfected and kept free from bacteria. The operation ended and the bleeding arteries secured with aseptic catgut, which is later absorbed, the parts concerned are completely disinfected and the dressing applied, which, impregnated with material that would prove destructive to any micro-organism entering it, is also calculated to exclude the atmosphere. The result is surprising. In many of the most serious operations, those on the brain included, the dressing often is not renewed but allowed to remain for a week or longer, and when finally taken off the parts underneath are found to have healed without a drop of pus having ever been present and without the temperature of the patient having ever ascended above normal, thus demonstrating the absence of all wound-fever, once so dreaded. Hospital gangrene, erysipelas, and puerperal-fever to-day are almost unknown. And this remarkable achievement is due solely to the results of bacteriological studies!

At the present time the most prominent investigators, the celebrated Koch in Berlin at their head, are endeavoring to find the proper remedies with which to antagonize the action of pathogenic bacteria. They are trying to discover a ptomaine which

will neutralize the effect of the pathogenic ptomaine producing each infectious disease. To relate here the details would carry us too far into the domain of organic chemistry. I may indicate, however, one other method, which, while having the same object in view, promises great success. Take, for instance, tubercular consumption. There are some animals that cannot be inoculated with the tubercle bacilli, because they are protected by nature against them. The question is, What substance in the blood — we believe it to be in the blood serum, that part of the blood which remains after the removal of the red and white corpuscles — of these animals prevents the development of the tubercular malady? If that substance can be isolated, the victory is won. Koch has taken some of the blood serum of an animal thus protected, and by transfusion brought it into the circulation of an animal specially predisposed to and inoculated with the disease. He succeeded in thus greatly diminishing the severity of the latter.

Professor Lister, on returning from his last visit to Koch in Berlin, said to the English physicians listening to his report, among other things, the following: "But while my lips are sealed with reference to the details, that much may I say, that before a few more years are passed the world will stand aghast at the discoveries made in Berlin. I have seen rats in the agony of lock-jaw, after the subcutaneous injection of a drop of fluid, within a few hours run about in perfect health!"

We are undoubtedly on the threshold of a new era, on the eve of a revolution, the greatest medical science has ever seen. The morning of a bright future has dawned; the light is ascending the horizon, and will soon shed its lustre from the meridian!

HOW TO MOUNT BIRDS WITHOUT REMOVING THE SKELETON.

BY ULYSSES O. COX.

To some, no doubt, it will seem useless to attempt to mount more than the skin of a bird; but, having had some experience with both methods, I wish to state what has been my success with the new one. The process is about the same that has been described by others, but the soap preservative is my own invention.

A pair of pointed scissors, scalpel, tenaculum hook, file, wire-cutters, several hooks of different sizes made of stiff wire, two pairs of forceps, one of the ordinary style and another with about one-eighth of an inch of each point bent out at right angles, are the tools that should be at hand. A dry poison should be prepared of one part arsenic and one part powdered alum. An arsenical soap should be made as follows:—

Group one.

Dry arsenic,	2oz.
Cake soap, any good,	2oz.
Potassium carbonate,	$\frac{1}{4}$oz.
Air-slaked lime, sifted,	$\frac{1}{4}$oz.

Group two.

Corrosive sublimate,	2dms.
Cyanide of potassium,	2dms.

Two or three moth balls, or one dram of camphor.

Put the first group in a vessel with enough water to dissolve it to the consistency of thick cream. Heat and stir until thoroughly dissolved. Dissolve the second group in another vessel in cold water, and when the first group is about cold stir in the second. Put the soap in well-corked bottles or cans. The cyanide of potassium, moth balls, and camphor, are not used for their preservative properties but to insure the specimens against moths or other insects.

A quantity of cotton, tow, wire of different sizes, and plaster of Paris should be at hand. For trial, select a medium-sized bird, say a jay or a robin, and clean off all dirt and blood-spots by first washing in clean water then drying with plaster of Paris. With the tenaculum hook catch the white coat of the eyeball and with a gentle pull remove the eye. Wipe the socket dry. Remove the other ball in the same way. With a wire, punch through the skull in the back part of each eye-socket and stir up the brain well. Fill the eye-socket with the dry preservative and stir it into the brain cavity. If careful, the brain can be so well poisoned thus that it will dry nicely. Fill the eye-sockets with cotton and proceed to the mouth. The forceps with bent points are for use in holding up the eyelids while putting in the glass eyes. Remove the tongue, and with it as much of the trachea and œsophagus as possible. Poison the mouth and throat well with the arsenical soap, and then sprinkle in a little of the powder. If there are any evident fleshy parts, chop them a little with the scalpel.

Open the skin from the tip of the sternum to the vent and push it back as far as you can conveniently. Remove the large muscles of the breast, working down to the wing; this can be done with a few strokes. Cut off as much of the loose flesh from the legs as you can conveniently. Open the abdominal cavity and with a stout hook remove the intestines. All the feathers may be protected from blood by taking a piece of tin and cutting in one side of it a deep U-shaped notch. The points of the U will fit up on each side of the bird. Several sizes of these tins will be found convenient. The intestines may be drawn out on the tin and removed. Wipe out the cavity with cotton, paint well with the soap, and then sprinkle it with the powder. Chop up the flesh at the root of the tail, and work the poison into it. After having thoroughly poisoned it, fill the body cavity with tow. Tow is preferable to cotton because wires are easily passed through it. Turn out the neck, remove the crop, œsophagus, and windpipe, hack up the flesh on the neck, and then thoroughly paint the skin and neck with the soap, and sprinkle with the powder. Your success depends on the care with which you put on the poison. Prepare two wires, one about six inches longer than the bird from head to toe, the other about the length of the bird. Pass the long wire into the bottom of one foot, up alongside the bones of the leg, just under the skin, through the body cavity, up alongside the neck, and out through the skull. Insert the second wire in the other foot in a similar way, but allow it to end in some of the bones of the body cavity. Place a little cotton in the space occupied by the crop, and begin at the neck to sew up the incision in the skin. Sew for a short distance, then fill the cavity underneath with tow or cotton. Be sure to fill it up well, for the parts will shrink some. Continue sewing until the incision is entirely closed.

With the bird on its back, spread out the wings and make an incision along the bones of each, press aside the skin, and poison the flesh well. If the bird is small, the powder is sufficient; if large, the soap should be used; and, when possible, some of the flesh might be removed. The bird is now ready to be set up, and here the method is no different from others. It will be found that, instead of the feathers on the back being displaced and ruffled, they are nice and smooth. A wire passed through the bend of one wing, through the bird and out through the bend of the other wing, then both ends bent over, will hold the wings in place.

As to time, I find that it takes me about as long to prepare a specimen this way as any, but my specimens are very much nicer. When the bird is poised, the tail and wings fastened, and the glass eyes set, there is little more to be done.

I have purposely placed some specimens thus prepared with some moth-infected birds. They have been there all summer, and, so far, are sound. If properly stuffed the specimens do not shrink and appear smaller than the original. If the muscles are well cut apart, the bird will dry just as poised. The largest bird I have tried to preserve in this manner is a great blue heron (Ardea virescens), and it dried nicely. I have several owls thus preserved. In the owls I took the brain out through the eye-socket. While large birds can be preserved in this manner, the method is better suited to small and medium-sized ones. Warblers and wrens, birds with very tender skins, are thus easily preserved. In such small birds as the warblers, only the pectoral muscle need be removed, but the others must be well chopped up and poisoned with the soap. Specimens for study, not mounted, can be nicely preserved by this process, and they are very durable.

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THE COMMUNAL BARRACKS OF PRIMITIVE RACES.

BY S. E. PEAL.

NOWADAYS, when the doctrine of evolution has taken such a firm hold of the scientific world, and the origin of marriage by capture is occasionally under consideration, it may not be out of place to draw attention to the remarkable communal barracks for the unmarried seen over such a large portion of the earth's surface among primitive races.

Many anthropologists have come to the conclusion that man has been from the first a pairing animal, and that the family was the primary unit. Mac Lennan, who has given us so much on primitive marriage, has endeavored to show that marriage by capture arose from a paucity of females due to female infanticide, and that some form of peaceful monogamy preceded it. But the accumulation of recent evidence tends to show us that, after all, Sir John Lubbock's surmise is possibly correct, i.e., that while marriage, or the private right to one particular female by any man, arose by capture, this stage of social evolution was probably preceded by one of communism, as in a small horde or clan. The existence of these singular communal barracks for the unmarried, as possibly the relics of such a stage, appear not to have been realized by anthropologists, hence it is desirable to draw attention to the large stores of information on this question already in hand but not utilized.

Letourneau, in his "Evolution of Marriage" (in the Contemporary Science Series), has exhaustively traced for us the early stages of marriage and the family among the lower animals, showing that it is by no means a peculiarly human institution. The various and peculiar forms of sexual association, past and present, he has clearly laid before us, but singularly enough has entirely omitted all account of these communal barracks, which apparently are unknown to him.

Under many forms and innumerable names, these singular social institutions extend from the Himalayas and Formosa on the north to Australia and New Zealand on the south; from the eastern Pacific and Marquesas to the west coast of Africa; and thus are found among races now classed as distinct, such as Dravidians, Indo-Mongols, Malays, Papuans, Polynesians, Australians, and Africans. Taken by themselves, these barracks for the unmarried are sufficiently suggestive; but when we notice that they are but one out of many peculiar social customs found surviving more or less among all these races, the case is doubly noteworthy, first, as evidence of former racial affinity; second, as an important factor in social evolution generally.

There seems to be internal evidence that their origin preceded monogamy, or marriage of any kind, and thus that some customs may outlast physical and even linguistic characteristics. As might naturally be expected, there has been marked geographical variation, not only in the barracks, but in the allied social customs, some of which have died out entirely. These customs are: Recognized sexual liberty before marriage, pile dwellings, head hunting, platform burial, aversion to milk, blackening the teeth, the double-cylinder bellows, large canoe war drums, tabu, tattooing, etc. Last, but most important of all, there is the universal tabu of these barracks to the married woman. She is not allowed in or, at times, even near them; whereas the unmarried young women and girls are not thus invariably prohibited, and in not a few cases are expected to sleep in them with the young men. In some races they have special houses or "barracks" built for them.

No doubt much remains to be discovered on this subject; but one thing seems to be already certain, that among all these races having "barracks," and where juvenile sexual indulgence is viewed as a harmless amusement, it was not the "horror of incest" which drove them to exogamy. With regard to these so called "barracks," it is necessary to point out that both in structure and function they vary so much that no description of one will cover all, except in so far as the tabu against the married woman is concerned. As a general rule, they are long houses, the recognized sleeping-places of the unmarried young men, council-halls devoted also to guests, and at times skull trophies, the guard-houses among head-hunting races, and canoe-houses in the Pacific.

Among the more civilized Buddhist shans of eastern Asam, the "Chang" is now a semi-temple, and school-house for boys, tabu to women. Among the Abors the "Mosup," 200 feet by 30 or so, is the young men's sleeping-house, also guest, guard, and council-house; among the less warlike Miri, the "Deri" is very similar, and also the sleeping place of the unmarried young women and girls. The Nogas call them "Pah," and being head-hunters in many cases, they are placed at the fortified entrances to the villages, being, as usual, on piles. The Mikirs call them "Tarenga," and the Lushais, "Zalbuk;" in both these cases they are the club-houses of the young men, and, as in most of the other cases, their authority dominates the community, even that of the parents over their offspring after ten or twelve years of age. Under elected heads they control a large amount of communal work, training and discipline of youths, clearing of roads, maintenance of fortifications, bridges, etc.

Amongst the Gonds, Kouds, Kols, etc., the "Damkuria" are the sleeping-places for the young men, boys, and girls, where they drum and dance to their heart's content. In Formosa the "Palangkans" are the guest and council-halls, the sleeping-places of the unmarried young men, issuing orders, and, as in all others, tabu to married women. Among the Battaks of Sumatra the "unmarried young men live together in a large house, sometimes of two stories, which is set apart for them." All over Papua we see the Dupu and Marea in every village as guest, council, and skull-houses, the sleeping-places for the young men, and tabu to women and children. In New Zealand the "Wharre Matoro" is still "the bachelor's hall or barrack, a Polynesian institution;" wharre meaning house, and matoro, "the advances made by young girls to the other sex." In the Louisade Archipelago, the Solomon Islands, and till lately in New Hebrides and Polynesia generally, the feature was common, the "Ti" of the Marquesas, 200 × 80 feet, tabu to women, being indeed fully developed ere marriage was common. Mr. J. Thomson tells us in Proceedings of Royal Geographical Society, Dec., 1884, p. 701, that among the Massai, "the boys and girls up to a certain age live with their parents; at 12 the boys and at 12 to 14 the girls are sent from the married men's kraal to one in which there are only unmarried young men and women. They live in a very indescribable manner till married." So pleasant do they find it that they seldom marry till past the prime of life.

The nomadic Australians are exogamic, and marry by capture or exchange; yet even here we seem to have a relic of the barrack system. Mr. Brough Smyth tells us that "the unmarried young men have a place set apart for them in each camp." Girls may entertain any of them as lovers till married. A man calls a woman of his own clan "Wartoa," or sister, and cannot *marry* her. Yet connections of less virtuous character which take place between them do not appear to be considered as incestuous. "Intercourse between the males and females belonging to the same clan appears to be regarded without disfavor," though *marriage* is very strictly prohibited between them. Thus the Australians, who (as Mr. Horatio Hale observes) are probably a degenerate race, practically live as roving communistic hordes, in which "marriage," or the monopoly of one female of their own clan is impossible (though sexual intercourse is permitted), a "marriage" being possible only by capture or exchange from another clan.

While, therefore, the prevalence of these singular communal barracks over such a vast area, and amongst such distinct races is a proof of great antiquity, their being so invariably tabu to the *married woman* amounts almost to a demonstration that marriage arose by capture. Thus what we now call the "wife," was the private property of the successful warrior.

As soon as property in captured spoils was recognized by races wherein there was sexual communism and hence less competition for females, the right of the stronger warriors to keep their female spoils (as wives) would be less disputed, and we may be certain that with the power they would have the desire to tabu to such females the communal quarters of the (unmarried) young men. Naturally it is with some reluctance and hesitation that one ac-

cepts these communal barracks as evidence of a former stage of promiscuity, and the universality of their tabu to the married woman as proof that "marriage" arose by capture; but the evidence all along the line (which is barely outlined here) seems to be irresistible. After all, perhaps, when we recollect that our ideas of incest, chastity, and modesty were pretty certainly as unknown to our remote ancestors as they are to some races even in our own day, it does not very much matter whether the primary "unit" was the family or the horde; if anything the horde is preferable.

A feature of the races having these barracks is (as a rule), that there are no juvenile marriages. At 18 or 20 the young women and at 20 or 25 the men settle down as fairly staid couples while yet in the prime of life, and divorces are rare. There are, as a rule, no old maids, and until civilized races appeared upon the scene, there were probably no prostitutes. Possibly a more extended research may reveal traces of the communal barrack system and its accompanying tabu in other countries; but enough has been stated to show that the subject is worthy the attention of all those interested in the question of the origin of marriage and social development.

Rajmai P.O., Sibsagar, Asam, Sept. 4.

THE UTILITY OF VEGETABLE ACIDS IN FOOD.

BY H. J. PATTERSON.

TECHNICALLY speaking, a food is generally described as a substance supplying material for maintaining the vital processes, renewing the waste and forming additional tissues in the animal system. It is a question whether it would not be well to broaden this definition so as to include those substances which serve the purpose of increasing digestibility and assimilation, and of preventing destructive metabolism. If these substances are not worthy of being classed as true foods, it may be well to class them as auxiliary foods. Whether the vegetable acids fall in the first class or in the second is still an open question; but they most probably belong to that of auxiliary foods.

The study of the definite character, quantity, and functions of the vegetable acids which exist in our foods has received but little attention, and consequently their true utility is but little understood or imperfectly defined. In the dietary of man acid foods have generally been considered to simply serve to gratify the senses of sight, taste, and smell, promote the appetite, and contribute to pleasure. It is well recognized that organic acids occur in small quantities in most feeding stuffs, but in the natural state they are generally in combination with bases. In the proximate analyses of foods the organic acids fall into that general dumping-ground of nitrogen-free extractive matter, and, with the rest of the members of that class, have until very recently received little or no attention.

It is a common practice in medicine to use vegetable acids to cause a decrease in the amount of flesh and to retard or stop flesh formation. Again, we know that in some cases these acids are used to facilitate digestion and to give a general toning up of the whole animal system. Some investigators have suggested that these acids have certain fuel values closely related to the carbohydrates, and that their combustion will save the consumption of other materials; this would class the acids as a true food. With the now almost universal use of silage and brewers' grains in our feeding economy with animals, and the considerable quantity of acids in the free state which are formed in the fermentation which these feeds undergo, it is a matter of considerable importance to know the true effect which these acids exert in the animal system, and whether they themselves are foods; whether they exert a beneficial influence on other foods; whether they aid or retard digestion, assimilation, and tissue and albuminoid consumption.

The investigations which have been conducted bearing upon this question have been very few and have not taken up the question as much in detail as it is desirable or as the matter deserves. The first experiment[1] in this line, and the one that brought this subject prominently before the author, was where a dog had been fed considerable organic acids in addition to his other food, exact records of the amount and composition of the food eaten and matter voided kept, with the result that there was produced a greatly increased consumption of the albuminoids. H. Weiske and E. Flechsig[2] performed experiments with a rabbit and sheep, feeding in addition to ordinary food the calcium and sodium salts of lactic and acetic acids; their results varied, but generally large quantities of the acids increased the albuminoid consumption, while small quantities had the opposite effect. A. Stulzer[3] compared the different organic acids found in feeding-stuffs and in the stomach in the artificial digestion of albuminoids, with the result that most of them have a high value. Acetic acid was found to be surprisingly low. We know from the investigations of Woehler and Lehmann that organic salts are changed in the animal organisms into carbonates and pass off as such in the urine. Charles, in "Physiological and Pathological Chemistry," states that oxalic acid, with animals in normal condition and when active oxidation is going on, rarely appears as such in the system, but is burnt into carbonic acid and water.

During the winter of 1891, experiments were made at this station by the author to test the effects of silage in connection with other foods on the digestibility of the different constituents and on the albuminoid metabolism. The foods used were corn-meal, wheat-bran, cotton-seed meal, germ feed, and gluten meal, in connection with corn-silage *versus* the same foods in connection with corn-fodder (stover). The animals used in the experiment were two one-year-old, and two two-year-old steers. The silage contained on the average 1.86 per cent free acid,[4] and as the two-year-old steers ate on the average from 20 to 25 pounds of silage per day, and the one-year-old steers ate on the average about 15 pounds of silage per day, this would make about 180 grams and 100 grams of free acid taken by the steers, respectively, per day. The two-year-old steers averaged about 950 pounds, and the one-year-old steers about 550 pounds. These quantities of acid are only from ½ to ¼ as much as were fed in the experiments of Weiske and Flechsig; with the smaller quantities they concluded that the acid served to conserve the albuminoids, and with the larger quantities to increase albuminoid consumption.

The average results of my experiments showed that with the rations containing the corn-fodder 38.7 per cent of the nitrogen fed was stored in the body, while with the rations containing the corn-silage there was only 26.6 per cent of the nitrogen fed stored in the body. From this we gather that even with small quantities of acid in the free state, they do not serve to conserve the albuminoids, but rather to increase nitrogen metabolism. The acid of the silage had a tendency to increase the digestibility of all the food constituents except that of the protein; this was slightly less digestible in the acid ration.

The experiments performed and the data at hand will justify the following summary: 1. Large quantities of vegetable acids, either in the free state or combined with bases will produce an increased consumption of albuminoids. 2. Small quantities of vegetable acids in the combined state and very small quantities in the free state have a tendency to increase the digestibility of foods and to decrease nitrogen metabolism or conserve the albuminoids. 3. The vegetable acids may, in some cases and to a slight degree, serve as conservatives of carbohydrates through their own oxidation. 4. That exclusive or excessive feeding of very acid foods, such as silage or brewer's grains, is detrimental to the animal, and causes a waste of the nitrogen or albuminoids of the food and of the animal body.

College Park, Md., Oct 8.

ON Tuesday, Oct. 18, there was opened a telephone line between New York and Chicago. The length of the line is 950 miles, which makes it nearly twice the length of any previously in regular operation. Professor A. Graham Bell was present and easily conversed with one of his early associates in telephonic work, who happened to be in Chicago. The formal opening of the line was made by Mayor Grant of New York, who conversed with the Mayor of Chicago at the other end.

[1] Reference lost.

[2] Journal f. Landw, 27, pp. 199-234.

[3] Landw Versuchs., 28, pp. 257-279.

[4] Principally acetic and lactic acids.

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BRAIN AND SKULL CORRELATIONS.

BY S. V. CLEVENGER, M.D.

THE sizes and shapes of skulls afford only unsafe anthropological and psychological generalizations. While the broad, the long, and the round heads are characteristic of certain races, they are even less invariably so than that the Mediterraneans are black-haired and the Norse are "tow-headed."

Heretofore crania have usually been studied as though it were possible to detach them from everything else in the universe. Their relationship to the contained brains, the phylogenetic and embryological development of the brain and skull together, and the influences of the one upon the other, have had but the most superficial consideration. The vast store of facts afforded us by modern biology, undigested and disjointed though they be, will yield unmistakable results if properly considered in relation to cause and effect association.

Every comparative anatomist has called attention to the occipital position of the foramen magnum of the lower vertebrates, and the tendency of this foramen to occupy a position farther forward in the ascending scale of the mammalia, until, in the primates, it is near, or at, the centre of the base of the skull.

In the *Journal of Nervous and Mental Diseases*, April, 1880, in an article entitled "Sulcus Rolando and Intelligence," I called attention to the different positions occupied by this fissure in different brains, showing that the sulcus of Rolando was placed farther backward in the adult than in the younger animal, and that it formed the posterior boundary of the frontal lobe, which, developing as the intelligence was greater, pressed backward upon the parietal and occipital brain, causing the cerebellum to be covered by the cerebrum; the lesser size of the frontal lobes allowing the brain to fall forward in its case, leaving the cerebellum of quadrupeds uncovered, and this same pressure from before backward, projecting the temporal from the occipital lobe, and the temporal, finding more room below, curled under and forward in its growth and forms the fissure of Sylvius. I also noted that this crowding backward of the frontal brain as it grew larger affected the development of the skull, and as the tendency of the animal to assume more and more the erect posture balanced the head upon the more perpendicular spinal column, that the spinal cord necessarily assumed less obliquity of junction with the brain base, until, in some men, the angle of the cerebrum and medulla oblongata is 90 degrees. At the same time, the forehead, by pressure of the brain from behind, had a tendency to become more prominent.

At a meeting of the Chicago Academy of Medicine, March 13, 1891, when a number of convict skulls were being examined, I reminded the Fellows present of the publication mentioned, and stated that if this lessened obliquity of the medulla could be accepted as an index to the greater intelligence of animals, there might also be an osseous adaptation of the occipital bone to the angle formed by the medulla and brain. I therefore arranged the skulls in a series from greater to less angularity of the basi-occipital or basilar process, and was assured by Drs. Lydston, Williams, and Talbot, who were familiar with the histories of the individuals whose skulls were thus arranged, that this estimation of their intelligence was a very good one. With a pardonable desire to fully establish my priority to this announcement, I will mention that there were present Drs. Lydston, Talbot, Moyer, Kiernan, Stillman, Lagorio, Zeisler, Pynchon, and Williams at this March 13 1891, meeting.

The exterior surface of the basilar process, unless compensated by differences in diploe thicknesses or in some other way, should give a corresponding inclination to the pharynx at the junction of the basi-occipital with the body of the sphenoid, and as many thousand observations would be needed to establish relationships of this kind, I have concluded to ask laryngologists and others who have occasion to frequently examine throats, to keep records of pharyngeal appearances and other data, from which deductions may be made, as follows: —

1. Inclination of posterior pharynx.

First degree, approaching the obliquity found among quadrupeds.

Second degree, obliquity less than first and greater than

Third degree, upright basilar process, or nearly so.

For the present, at least, more divisions between perpendicularity and the horizontal can scarcely be made in the living person, owing to muscular, mucous, and other coverings varying in thickness, enabling rough estimates only. A separate set of observations should be made upon skulls, where sufficient was known of the history to form an estimate of intelligence, the base for measurements being the same as with Camper's angles.

2 Shape of skull — brachycephalic, dolichocephalic, mesocephalic.

3. Size of skull, large, medium, or small for the age, height, or sex.

4. Intelligence.

5. Education.

6. Camper's angle.

7. Other information not included above, as to disease or injury affecting skull or brain, criminality, insanity, etc.

The correlations should be accepted as inter-dependent and not disconnected. For example, instead of intelligence being indicated by a high, wide, bold forehead, there may be hydrocephalic idiocy, and, generally speaking, we may sum up some cranio-cerebral peculiarities thus: —

1. The more erect position tends to move the foramen magnum forward. Increased intelligence and erectness are generally, but not invariably, associated in animals, so the position of the foramen alone as an index has a restricted value.

2. The frontal brain-growth is always associated with increased intelligence, and this development crowds the sulcus of Rolando farther back and pushes the medulla oblongata and pons Varolii into a more and more upright position, provided the brain-growth is greater than that of the skull, for a roomy skull may afford expansion and allow the primitive obliquity of medulla and occipital bone to persist.

3. The adjustment of the skull to its contents is a complex matter, but may be better understood by relating cause and effect as acting upon both more or less simultaneously, particularly with regard to the differences in hardness and developmental changes in both. For example, the beaver's skull and brain seem to have kept pace together so as to render convolutions unnecessary, and the beaver is an intelligent animal. The brain of Professor Leidy was highly convoluted, and appears to have been rendered so by his cerebral being greater than his skeletal growth, and this would seem to have been a family peculiarity, for his brother's brain presented a similar appearance of crowded convolutions.

4. When a juvenile retreating forehead has gradually been replaced in an adult by a more perpendicular one, through education acquired later in life, then the frontal brain may have crowded

and formed more numerous convolutions and fissures in consequence, but the pharynx may not be changed from the original inclination.

5. The softer brain is likely to undergo more rapid changes than the harder skull, either in the evolution of species or the individual, and the mere cranial conformation may or may not, therefore, be an index to brain area and intelligence, and whatever changes may occur in the skull due to brain increase have reference more to enabling the brain to find room in the cranium, so that a higher forehead may render the more erect basi-occipital unnecessary, or *vice versa*, and normal or abnormal growth of brain may raise both osseous portions.

Some mongrel dogs may inherit a larger brain from one parent and smaller brain-case from another, which would account for the deep indentations in their skulls, the pressure causing them sometimes to suffer from epilepsy and other brain derangements; this disparity is not likely to be so great in the offspring of better-mated species.

6. Many other matters could be considered, such as centres of ossification and cartilaginous persistence between such parts as the basilar process and sphenoid, enabling adjustment of the pharynx to the changed medulla angle.

70 State Street, Chicago.

INDICATIONS OF A RAINY PERIOD IN SOUTHERN PERU.

BY A. E. DOUGLASS.[1]

It is sufficiently easy to assert that at some remote period this country had abundance of water; but very few writers have taken the trouble to point out the actual indications to that effect.

There are two causes which operate to make this climate dry. The first is found in the south-east trade-winds being stopped by the high mountain ranges in the interior to the east of us. The second consists in the fact that the winds which do reach our sea-coast come from the colder regions to the south, and consequently will take up moisture and not deposit it. Therefore, a change from a wet to a dry climate was probably caused by a considerable increase in the average elevation of the Andes. If such was the case it must have occurred at some very remote period.

Before entering fully upon the subject, it is safe to remind one's self that a small amount of water acting through a great length of time can accomplish almost as much wearing as a great amount in a short time. Therefore, the numerous large and deep ravines in this region do not necessarily indicate a great quantity of water at some past epoch.

The purpose of this paper, then, is to point out some particulars which indicate that at some geological epoch there was abundance of water in this region. Unmistakable evidence has been found in two places: on Charchani and on the Pampa of La Joya.

A trip to the observatory meteorological station on Charchani, at an altitude of 16,650 feet, reveals many interesting facts. The green valley of Arequipa seems to be alluvial flats of river and perhaps lake deposits; the pink-colored pampa of Uchumayo is evidently the original volcanic tufa; while the dark-brown pampa, stretching out some ten miles from the mountain and containing a very thin vegetation, is an enormous "wash" from the mountain itself. In this is shown a water action on a scale surpassing anything that can be found about the city itself. If Charchani is a remnant of an ancient crater-ring, as seems not improbable, then a portion half as large as the present mountain has been washed down into the valley.

But there is a still more noticeable feature on the mountain itself. At an altitude of about 14,500 feet, on the ridge west of the great central ravine, the road passes for perhaps half a mile through an area of bowlders worn by water action into all sorts of curious and fantastic shapes. The rest of the ridge to its top is a regular glacial moraine of gravel and bowlders. On leaving this ridge and reaching the final slope to the summit, a little below snow-line, one finds every ledge of rock smoothed and polished on the surface, with long shallow scratches pointing down the mountain — proofs of glacial action. These striated ledges are especially noticeable at and just below the meteorological station. Therefore, at some period this pocket where our station is, between the main summit and the broken ridges to the east, was filled with ice to a depth of a thousand feet or more. This glacier slowly moved downward, completely filling the valley and at some point separating into two streams, one of which filled the great central ravine down to the spring, Canchero, and the other turned more to the west, going down probably to the same altitude of 13,200 feet.

Now the significance of an enormous glacier on Charchani is this: ravines and river valleys can be made by a small amount of water acting through a long period, but glaciers cannot; the water, or snow, must be all there at once. Moreover, the greater the supply of snow for a glacier the farther down the mountain it will come. Now, the temperature of this spring at noon of April 12, this year, was 45.5° F., and it will be shown later that the land had a less elevation in the rainy period than at present. The climate could not, therefore, have been colder. As this glacier came down to an altitude where the mean annual temperature was considerably above freezing, as shown by the present temperature of the spring, the snow supply must have been not merely moderate but quite abundant.

If we had rain enough at the present day to make these dry pampas the gardens they might be, this glacier would be seen on Charchani.

The evidence to be found on the Pampa of La Joya is equally conclusive but not equally striking. Not far below Vitor is a large ridge of volcanic mud to the west of the track. This ridge runs about north-east and south-west, and is bounded along its south east side by an open cliff where the bank has been caved away by a river flowing against it. Stretching away from this bank is the old river-bed, very broad and shallow. At a higher level, to the east of the track, the river-bed contracts into a narrow and deep channel. A surface river on the Pampa of La Joya would necessitate vastly more abundant rains than at the present day. There must have been a supply greatly in excess of the loss by evaporation or sinkage into the earth.

There are other facts also which bear on this question. Lake Titicaca once covered many times its present area. Innumerable shell-fish lived in its waters, whose remains are now found as fossils at Chililaya, Huancané, and other places, many feet above the present lake-level. The signs of this increased size are still so evident and the fossils are so much like the living species of shell-fish, that, geologically speaking, the rainy period which caused this increase and at a lower altitude supported a tropical vegetation was recent; historically, of course, its antiquity was immense. The palaces and houses on the island of Titicaca were built with the lake at practically its present level, and Tiahuanaco is not more than 150 feet above it. Coal deposits are found on the island of Titicaca and at Sumbay, but the tropical vegetation which formed them must be placed in a past so remote that the enlargement of Lake Titicaca and the glaciers on Charchani are but as yesterday.

In the beginning of this article I referred to the fact that an increase in the elevation of the mountains to the east of us may have caused the climate to become dry. That such an increase has occurred in recent geological times can scarcely be doubted. From above Tambo station down to the present sea-level traces of surf-action may be found. That means that the coast has been gradually rising out of the sea to the extent of 1,100 feet in recent geologic times. Whether it did it with perfect regularity, by occasional periods of rapid rising, or by sudden elevations, a thorough examination of the region would show. At Mollendo it is evident that the coast has not risen more than two or three feet in the last hundred years, if it has risen at all, and the fact that guano has been accumulating on the islands along the coast for many thousand years indicates that for a long period the coast has been practically stationary. Nevertheless, there can be no doubt that the last change in the coast-level was a rise of 1,100

[1] First assistant at the Boydun station of the Harvard College Observatory, Arequipa, Peru.

feet. That, to be sure, was not very much, but it must have materially altered the relative lengths of the wet and dry seasons.

Thus we have direct evidence to the following effect: For many thousand years, going back far beyond the recognized period of human habitation, the climate has been very much as it is at present. That was preceded by a slow rise of the land out of the sea, which caused the climate to change from wet to dry. But under the wet climate the elevation of the land was still too great, and perhaps the duration of the epoch was too short, to produce a luxuriant tropical vegetation; otherwise there would be to-day extensive coal-fields. However, the wet climate was sufficient to greatly alter the face of the country. Lake Titicaca was of enormous area, fed perhaps by the melting glaciers. In the almost continuous rainy season, huge turbid rivers roared and tumbled down these western slopes of the Cordillera, while on each mountain summit vast quantities of snow fell, only to pursue its way down the steep slopes, carving out valleys, building up ridges, and by its melting wearing out deep ravines, which grow smaller as they become lost in the broad level plain below. Under such luxuriance of moisture the valley of Arequipa must have teemed with animal and vegetable life, the barren hills to the south were clothed in green, and the desert of La Joya blossomed like a garden.

CURRENT NOTES ON ANTHROPOLOGY.—XVII.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Ancient Vans.

THE people who in proto-historic time lived at the foot of Mount Ararat, on the plains around Lake Van, and about the head-waters of the Araxes, were known to Herodotus as the Alarodi, which is a Greek form of the Assyrian *Urartu*, of which Ararat is the Hebrew form. They seem to have called themselves Chaldeans, *Chaldi*, but their language was neither Semitic nor Aryan. They learned to write it in cuneiform characters, and a considerable number of their inscriptions have been recovered, dating 750–850 B.C., about.

In a late number of the *Zeitschrift für Ethnologie* is a valuable contribution to our knowledge of these inscriptions by Messrs. Belck and Lehmann. The former traversed some five thousand kilometers of Russian and Turkish Armenia last year, and carefully copied quite a number of hitherto unknown Vannic inscriptions; to the decipherment of which Dr. Lehmann devoted himself with much success. They date from half a dozen different reigns previous to the destruction of the Vannic kingdom by Tiglathpileser in 742 B.C.

The most interesting, the longest, and the most difficult to decipher, on account of the new words and ideograms it contains, is one from the stele of Rusas. It apparently was set up to celebrate the completion of some important works in irrigation and laying-out of gardens and orchards.

The inscriptions are carefully reproduced in autotype, and offer new and valuable materials for students of this little-known tongue.

Laws of Human Evolution.

The most valuable summary of the facts and laws of human evolution that I have seen for a long time is contained in the Cartwright Lectures for 1892, delivered by Professor Henry F. Osborn of Columbia College, New York. These admirably clear and able addresses, three in number, discuss the many knotty questions involved in this topic with temperate judgment and a complete mastership of the facts.

Many of his conclusions are of the utmost importance to the practical anthropologist, and to the majority will have a novel force; for instance, that man is anatomically quite degenerate, only his hand and his brain comparing favorably with mammalian anatomy generally. He is now in a state of very rapid evolution, or rather transformation, for, according to our author's figures, more than thirty of his organs are degenerating to twenty which are developing. This action is especially active in certain centres, of which eight are mentioned; but in them the rate of change is by no means uniform. The most conspicuous variations are reversions, and in the matter of advance, the evidence is abundant that structure lags far behind function.

In the muscular system the evolution of a new type consists in the accumulation of anomalies in a certain direction by heredity. There are on the average nine anomalies of the muscles in each individual. How these come about is variously explained. The French theory that all anomalies reproduce earlier normal structures, seems too absolute. Here comes in the puzzling question as to what is the active force in producing variations, and preserving those which are valuable to the species. After a careful review of the evidence, the lecturer reaches the conclusion that the theory of use and disuse, along with the hereditary transmission of acquired variations, encounters less difficulties than that of the accumulation of fortuitous favorable variations by natural selection.

Of course, the theories of Weissmann, that acquired traits do not become hereditary, have to be considered, and are not found to be sufficiently established.

Suggestions for a Universal Language.

The evolution of linguistics is in two opposed directions; on the one hand, there are societies and patriotic guilds constantly cultivating and preserving dialects and isolated languages, printing papers in them, and trying to make the rest of the world learn them; and, on the other, there is a growing party demanding that some one or a very few tongues be adopted for the general commercial, social, and scientific business of the world. The latter class is again divided into those who would select one or two of the already existing languages, and their opponents, who think a new and simple tongue bad better be manufactured for the purpose. Of the latter the *Internationale Weltsprache Gesellschaft* of Vienna is among the most active. It has just issued a "Grammatik der Weltsprache" (Mondolingue), which is but one of its many publications in favor of the tongue devised by Dr. Julius Lott, from whom (Wien, II. 2. Schüttelstrasse 3) these publications may be had.

Professor A. MacFarlane of Austin, Texas, has also a valuable paper in the Texas Academy of Science Transactions, on "Exact Analysis as the Basis of Language." He reaches the conclusion that a natural language is better suited to scientific development than one which is artificial. Another recent writer on the same subject is M. Raoul de la Grasserie of Rennes, France.

Languages of the Gran Chaco.

The extensive district in northern Buenos Ayres called El Gran Chaco, "The Great Hunting-Ground," has been linguistically almost a *terra incognita*. Inhabited by numerous roving tribes of uncertain affinities, up to the present time we have had of its numerous dialects only one published grammar, and for it no corresponding people could be found, none who speak the tongue which it sets forth!

This want has now been happily filled by two publications which have been issued by the Museo de la Plata; the one, a work composed in 1856 by the Rev. Francisco Tavolini, entitled "Reglas para aprender à hablar la Lengua Moscovita;" the other, by Samuel A. Lafone Quevedo, "Principios de Gramatica Mocovi." Both refer to the same dialect, better known as the Mbocobi. It is closely allied to the Abipone and Toba, and is a member of the stock which, in my "American Race," I have designated by the Tupi term, "Guaycuru."

The two works are in a measure supplementary, Mr. Lafone Quevedo having made use of previous writers, principally Barcena, Dobrizhoffer, and Tavolini, to form his analysis of the tongue. He is also the editor of Tavolini, and holds out the promise of other grammars of the Argentine languages, from unpublished sources. We who interest ourselves in such studies, shall look forward with interest to this series, and hope that the financial storms of the Argentine Republic will not delay its appearance.

The Origin of Punishment.

The young science of ethnologic jurisprudence is one of the branches of anthropology destined to throw unexpected light on the origin and significance of many of our daily customs and beliefs. A most important contribution to it has recently appeared from the pen of Dr. S. R. Steinmetz, on the early development of punishment ("Ethnologische Studien zur ersten Entwickelung der Strafe." Leiden, 1892). It is the second volume of the work, which, for various reasons, has been published first. His aim has been, first, to offer to students an extensive collection of facts drawn from the customs of primitive peoples regarding the question of punishments; and, second, to analyze their sociologic and psychologic significance.

The present volume begins with a chapter on blood revenge, tracing its development into the ordeal and the trial by battle up to the modern duel. The effects of blood revenge on social condition are pointed out, some being highly advantageous, others evidently injurious. The administration of punishment by the state is treated with much clearness and from a wide range of reading. It is shown to have developed from the systems of correction adopted in the primitive family, and was often in the nature of a compromise or blood money. Several chapters of special interest relate to the position of woman with reference to family feuds and revenge, and the authority over the males which she exerted in various communities, some of matriarchal, others of patriarchal constitutions. The intense bitterness of her feelings, and her ferocity, far ahead of that of men, are referred to and illustrated. The punishment of slaves and that of military discipline are also discussed. A curious closing chapter is added on the punishment by the gods, in this world and the next, and its influence on human punishments. It will be seen from this brief reference how extremely interesting the book is.

SCENTS AND THEIR RECOGNITION.

BY J. W. SLATER, LONDON.

THERE are some points connected with both the production and the recognition of odors by animals which seem to need further study. It is agreed that all species possessing the sense of smell at all, like and are attracted by the scent of their usual food, or of substances of a similar character. We have also evidence that animals are agreeably impressed with the specific odor of their own species, or of their own race or strain. On the other hand, they are disgusted and repelled by the emanations of hostile species.

These are results which we might expect on evolutionist principles, and which we actually detect whether we ascribe them to Professor Jäger's "soul-particles" or not. It is sometimes forgotten that peculiar odors not merely aid in the diagnosis of different human races but contribute no little to keep such races asunder. That the odor of the Negro or of the Australian "black-fellow" is repulsive to the white man is a familiar fact. But the aborigines of South America distinguish in the dark the smell both of the Negro and of the white man from that of their own race, and dislike the two former about equally. Even the two great branches of the white race, the Aryan and the Semitic, have a different and in many cases a mutually repulsive odor. During the recent anti-Semitic agitation in Germany and Austria the *Fœtor judaicus* did not escape comment.

At the same time we observe a few cases which we cannot well account for on the principles above laid down. Instance the feline group; the natural food of all such beasts is the flesh and blood of animals recently killed, and even in case of need, carrion. We might expect that beings habituated to such a diet would prefer odors not merely unlike but opposite to those which mankind select. Yet the fact remains that not merely the domestic cat but the leopard is passionately fond of the very same perfumes which we enjoy. Lavender, thyme,—in short, most plants rich in essential oils have a well-known fascination for the cat. Leopards have been charmed into docility and submission by means of lavender water. The difficulty becomes the greater if we reflect that nothing similar has been observed among the canidæ which have a much more acute sense of smell than the cats. I suspect, though I cannot furnish distinct proof, that the plants in question act upon the felidæ as aphrodisiacs. What may be the reason why cats so persistently browse away *Nemophila pulchella*? Its cultivation in London suburban gardens may be pronounced impracticable except under the protection of wire-screens.

THE PERCOPSIDÆ ON THE PACIFIC SLOPE.

BY CARL H. EIGENMANN, INDIANA UNIVERSITY.

THE Percopsidæ have hitherto been known from a single species having a very wide distribution. This species was discovered by Agassiz and described in his "Lake Superior."[1] He considered it a generalized type and relic of an older fauna. Professor Agassiz says (285): "Now the genus *Percopsis* is as important to the understanding of modern types as *Lepidosteus* and *Cestracion* are to the understanding of the ancient ones, as it combines characters which in our day are never found together in the same family of fishes, but which in more recent geological ages constitute a striking peculiarity of the whole class. My *Percopsis* is really such an old-fashioned fish, as it shows peculiarities which occur simultaneously in the fossil fishes of the chalk epoch, which, however, soon diverge into distinct families in the tertiary period, never to be combined again. . . . Now my new genus, *Percopsis*, is just intermediate between Ctenoids and Cycloids; it is, what an ichthyologist at present would scarcely think possible, a true intermediate type between Percoids and Salmonidæ."

During the past summer I made a series of collections of fishes through south-western Canada and the north-western United States. I collected in the streams emptying into Hudson's Bay and the Gulf of Mexico on the Atlantic side, and into Puget Sound and the Columbia River on the Pacific side of the continent. *Percopsis guttatus* Agassiz was found to be abundant in almost all the streams tributary to Hudson's Bay, from the Red River of the north to the Saskatchewan at Medicine Hat. In the Bow at Banff, at an elevation of 4,500 feet, it was no longer seen. The species seems to belong to the plains. It extends south to the Delaware River and Kansas, but is only rare south of the Great Lakes. It was not found in the Columbia at Revelstoke or at Golden, where collections were made, and which are nearly directly west of the localities where it was found to be so abundant, nor was it expected in these localities. When on my return trip I came to Umatilla, where the Union Pacific leaves the Columbia, and I noticed the favorable conditions for collecting, I concluded to stop, although the place was not on my itinerary and I would have but a short time for collecting. The Umatilla is a small stream which expands over a sand strip to form a shallow lagoon before emptying into the Columbia. I reached the station Sept. 6, at 5.20 P.M., and began work at once, as it was necessary to leave again at 4 the next morning. I was more than surprised to find that one of the most abundant fishes was a species of *Percopsidæ*, and that by this find the known habitat of this family was extended to the Pacific slope. Fishing was confined to the lagoon at the mouth of the Umatilla and to the Columbia immediately above this place. During the short time at my disposal over one hundred specimens of this family were obtained. No specimens were found in the Snake and its tributaries. It is really surprising that a species so abundant should have escaped detection till now unless its distribution is quite limited, as its absence at Golden and Revelstoke seems to indicate.[2]

The specimens prove to belong to an undescribed genus. The genus is more specialized than *Percopsis*, but still bears out Agassiz's idea of the family. It approaches much nearer the *Percidæ* than *Percopsis*, in that its dorsal and its anal fins are armed with strong spines, and its scales are much more ctenoid. In other words, its percoid affinities are much more pronounced than are

[1] Lake Superior: Its Physical Character, Vegetation, and Animals, Compared with Those of Other Regions. Boston, 1850.

[2] The elevation of Umatilla is given to be 300 feet by the Union Pacific Railway estimates.

those of *Percopsis*. The genera may be distinguished as follows: —

A. Dorsal with two feeble, slender, unbranched rays; anal with a single similar ray; scales most strongly ctenoid on caudal peduncle; posterior margin of preopercle entire or with feeble crenulations; form slender. *Percopsis*.

AA. Dorsal and anal each with two very strong spines; scales most strongly ctenoid on anterior part of body; posterior margin of preopercle with a few short but strong spines; form heavy, deep. *Columbia*.

Diagnosis of *Columbia transmontana* E. and E., sp., nov.: —

Head, $3\frac{1}{4}$–$3\frac{1}{2}$ (3 in the young); depth, $3\frac{1}{4}$–$3\frac{3}{4}$ (4 in the young); dorsal, II., $9\frac{1}{2}$; anal, II., $6\frac{1}{2}$; scales, 769–44 to 46–7.

Body comparatively deep, the dorsal profile more arched than the ventral, making an angle at the origin of the dorsal fin; sides compressed, caudal peduncle most so. Head short and chubby; eye equal to snout, about $3\frac{1}{2}$ in the head. First dorsal spine about equal to the pupil, second spine one-half length of head, recurved and very deeply grooved behind. Anal spines somewhat lower than the dorsal spines; ventrals reaching past vent. Nape, with the exception of occipital spine, scaled. Translucent in life. Color generally smutty. Side with three rows of more or less oblong blackish spots, the middle and superior rows most noticeable. Back with a series of similar spots, one being conspicuous at beginning and end of first dorsal. Dorsal mottled, caudal barred. Head smutty, a blue-black spot on middle of opercle, a narrow, silvery, lateral band. Young translucent, with well-defined dark spots.

The greater part of the specimens belong to the British Museum.

MICHIGAN MINING SCHOOL.[1]

The committee appointed by you to act as a Board of Visitors to the Michigan Mining School respectfully report as follows: Finding it impossible to arrange a date which would enable the entire committee to make the inspection at the same time, two of us visited the institution on Wednesday and Thursday, March 30 and 31, and the third on April 8 and 9. We were cordially received, and every effort was made to place us in possession of the items asked for and appertaining to the duties assigned us. The examination was as careful and searching as time would permit.

The first visit was made during the progress of the regular work, and the second during examination week at the close of the term. Thus the opportunity was afforded the committee of witnessing the work of students in the class-room and laboratories, as well as the results of that work as exhibited by the examinations. So far as we are able to judge, the work of the institution is being pushed along its legitimate lines and solidly and conscientiously performed both by students and instructors. The lectures indicated carefulness of preparation and thorough understanding of the subjects taught on the part of the instructors, and the character of the examinations showed that there was no disposition to accept less from the students. We were favorably impressed with the earnestness of purpose which seemed to pervade the students as a body, and with the manifest fitness of the members of the faculty for their special lines of work. Some of these men, we understand, left much more lucrative positions on account of their love for their specialty, and their desire to devote themselves exclusively to it. Such men cannot fail to do strong work. It was with regret that we learned, soon after our visit, of the resignation of Dr. Keller. He is unquestionably one of the ablest men in the institution. The building, rooms, laboratories, apparatus, and machinery all indicate efficiency on the part of those having them in charge. The Mining School is purely and distinctly a professional school, having for its object the practical training of its students in mining engineering, and we believe it is carrying out the purpose for which it was established. Of course, much of the theoretical is taught, but so far as your committee could learn, it is with sole reference to its practical bearing upon what is to follow.

[1] Report to Hon. Ferris S. Fitch, Superintendent Public Instruction, Michigan, by a committee consisting of D. A. Hammond, Perry F. Powers, and S. E. Whitney.

Although much time is spent upon theoretical mathematics, the object is to give the student a mastery of those principles which will be necessary in his after work of surveying and engineering. The students are then taken to the field and into the mines, and, under the guidance and direction of an expert (Professor Denton), are taught the practical applications of the principles learned, and other necessary operations of mining. The same methods prevail in the other departments of the school. It is this element of practicability in all the work of the school, in our opinion, which has brought to the school the very general support of the people of the Upper Peninsula and of mining men in particular. The consensus of opinion among all classes is that the school has a direct and financial value to the State. It promotes intelligence in methods of mining, develops inventiveness in the line of mining machinery, and directs thought to measures for securing greater safety to miners.

Your committee, or at least one member of it, before visiting the school had always regarded it as an expensive one considering the number of students enrolled. But after careful investigation at the school and an examination into the methods pursued by the Board of Control, there can be do doubt but that all means appropriated have been economically and intelligently expended. Of course it is well understood by all that technical education is necessarily much more expensive than general education, on account of the peculiar character of the work. The equipment, including buildings, laboratories, apparatus, machinery, and collections in geology, is very costly. A comparison of the per capita cost at the Michigan Mining School, however, with the cost at other similar institutions shows that the Michigan school is among the cheapest. This cost will decrease as the number of students increases. The faculty as at present constituted could undoubtedly handle a larger number of students than are now enrolled in the school (76), and yet the work of the various departments could not be satisfactorily performed with a less number of instructors. In fact, were it not for the union of the school and the geological survey, the faculty would have to be increased; but this arrangement adds to the teaching force for a large part of the year three skilled assistants, Drs. Lane and Patton and Professor Seaman.

This brings us to the consideration of the question of the union of the mining school and geological survey. We believe this arrangement to be mutually advantageous and a direct saving to the State. It places at the head of the Survey, as State Geologist, the Director of the school, Dr. Wadsworth, who is eminently qualified both as to scholarship and executive ability for the positions he holds, and strengthens the faculty of the school by adding to the teaching force the three capable members of the survey. With the means at the command of the Geological Board it would be impossible to retain the services of these men; but by dividing their time between the survey and the school, and receiving a part of their salary from the survey and part from the school the State is enabled to retain them in its employ. It also furnishes convenient headquarters for the survey and places at the service of the school its valuable geological collections. At no other place in the State could this collection be so well preserved and made of such practical value. The wisdom of locating the school where it is, is apparent to all who have ever visited this region. It is surrounded by some of the richest copper and iron mines in the world, and the student has the opportunity of making constant practical application of his studies. Some means, however, should be adopted at once to reduce the expense of living to the students. We understand that it is very difficult for the students to find rooms and board without paying exorbitant prices therefor. If means could be devised for relieving this condition of things it would be well, in fact, it is almost imperative that something be done in this direction. There ought to be a room at the building, also, large enough for an assembly-room. There are many occasions when it is quite important to bring the students together in a body. We believe, also, that the heating apparatus should be removed from the main building and placed in a building by itself.

The Michigan Mining School, we may say in closing, has come to stay; because it has demonstrated its fitness to live. Whatever

may have been its weakness in the past it is now doing valuable work. It is well equipped, has an able Faculty, and a demand upon it greater than it can now supply. We see no reason why it should not be a very valuable auxiliary in the future development of the mining resources of the State.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

On the Interpretation of the Markings on Mars.

IN view of the large mass of conflicting observations of Mars now being reported, it occurs to me to mention one principle of interpretation which has not to my knowledge been suggested. On Mars, as on the moon, may it not be true that the most conspicuous permanent markings are due, not to land and water surfaces, but to contrast of mountain and plain? Mars through even a large telescope is brought scarcely closer than the moon appears to the naked eye, and it presents a general marking analogous to the "man in the moon," which we know to be but a shadow feature. (See, for example, Plate xxxiii. in *Astronomy and Astro-Physics*, October, 1892). If the permanent water surface of Mars is only one-half the area of the Mediterranean Sea, as lately estimated by Professor Pickering, it is, of course, impossible that the light and dark patches represent land and water; but the supposition that they represent, in general, open plain and rugged hill-country throws light on certain perplexing phenomena. The so-called canals are then probably mountain ranges separated by plateaus, and the so-called duplication is a bringing out by higher powers of outlying spurs and ranges, which with lower powers are either indistinguishable or mingled with the general mass. As our seeing improves, we may expect triplication, quadruplication, etc. An observer on Mars looking through a telescope at the Rocky Mountains from a distance of 100,000 miles would discern merely a long dark blur, while upon closer scrutiny he might distinguish parallel and off-shoot ranges with their foot-hills as separate dark lines, which might be termed "canals." The apparent straightness and regularity of the "canals" is doubtless the effect of distance.

By this interpretation we solve the difficulty suggested by Professor Pickering in *Astronomy and Astro-Physics*, October, 1892, p. 669, that some "very well developed canals cross the oceans." These "canals," then, are hilly peninsular extensions or ranges of mountainous islands. From Mars, Italy or Java would appear but as dark streaks in a greenish or bluish medium. Mr. Barnard mentions in the same number (page 683) that "long luminous streaks" seem to be a definite feature of the planet's surface. These are probably lines of snow-capped peaks. We must, on the whole, believe that the seas, lakes, and canals of Schiaparelli's map are as mythical as the seas of the moon.

When one compares the extremely diverse drawings of Mars given in the October *Astronomy and Astro-Physics*, one cannot but suspect that clouds have a large part in producing this diversity. The general appearance of the earth from Mars would certainly change from hour to hour from this cause alone. Predominant and cloud fog probably caused the "absolutely colorless, dark-gray" appearance of the Martian oceans, noted by Professor Pickering for a considerable time (*Astronomy and Astro-Physics*, p. 346 cf., p. 669). Similarly the North Atlantic, which might often appear from Mars as a blue or green spot, might for some time, in the spring of the year especially, be a dark-gray patch.

We must consider it likely that some of the rapidly darkening spots which Mr. Pickering observed were due rather to springing vegetation caused by showers on barren tracts than to inundation, particularly the case he mentions where a dark area suddenly appeared to the "south east of the northern sea and of fully double its area." It seems hardly possible, if the snows on Mars are as light as Professor Pickering represents, that such extensive inundations could occur; and it is simpler and more in accord with general analogy that many such temporary dark or gray-green spots should be due to vegetation rather than to water.

Professor Pickering did so admirably with his 13-inch instrument, that we may well believe that, if he had had a 30 or 40-inch telescope, he would now be able to give us a tolerably accurate account of the general physiography of Mars. We hope his appeal for a thorough equipment will meet a ready response.

HIRAM M. STANLEY.

Lake Forest University, Oct. 11.

The Lines on Mars.

IN *Science*, Sept. 23, Mr. C. B. Warring communicates a theory to account for the gemination of the so-called canals of Mars. He suggests that the phenomenon may be due to a defect in the eye of the observer by reason of its possessing the power of double refraction in some or in all directions. That some eyes do possess the power of double refraction is a well-known fact. It is a defect which, I imagine, is much more common than is generally supposed. It may be suggested that data representing a large number of cases *might* show astigmatic eyes to possess the power of double refraction more frequently than others. I do not know that any data have been collected upon this point.

Concerning the existence of the canals of Mars and that they are sometimes really double, I have no doubt. My own recent work at the Lick Observatory has convinced me that they are not illusions due to imperfect eyesight. During the present opposition, I spent about thirty nights in the work on Mars, working with Professors Schaeberle and Campbell. On about half the nights I saw the so-called canals with more or less distinctness, but on only one occasion did I clearly see a canal double. This was August 17, when the canal called Ganges on Schiaparelli's map was clearly seen to be double, and was so drawn in my note-book. That the doubling was real and not apparent is evident from the fact that Professors Schaeberle and Campbell both saw the same canal double on the same night, and drew it so. Other canals, some of them nearly parallel to Ganges, were seen that night, but none of them appeared double.

Our work was done independently. In turn each went to the telescope, and made a drawing of what he saw. We did not see each others' drawings, nor did we talk of what we had seen. It was not until the next morning that we learned that each had seen Ganges double.

WILLIAM J. HUSSEY.

Leland Stanford, Jr., University, Palo Alto, Cal.

A New Habitat of the Black-Throated Rock Swift, Micropus Melanoleucus.

As curator of the museum, I have just procured for the State University of Nebraska a set of bird-skins prepared during the past summer, among which are five skins that must be of interest to ornithologists. They verify the discovery made by Professor Lawrence Bruner of the University of Nebraska, that the White-throated Rock Swift builds and breeds in the precipitous bluffs around Squaw Canon, Sioux Co., Nebraska, and, what is more likely, throughout the Pine Ridge regions, as Professor Bruner has observed them also at Crow Butte, near Crawford, Nebraska.

This isolated habitat of the White-throated Rock Swift, Micropus Melanoleucus (Panyptila Saxatilis), is several hundred miles east of its most eastern limits as known hitherto. Perhaps the Pine Ridge Buttes and bluffs, particularly those about Squaw Canon, are so admirably adapted to their nesting and high-flying habits as to be the attractive forces.

Although five specimens were secured, no eggs were found. It should be mentioned, perhaps, that the egg of this swift is unknown. However, it is the expectation of the author that they will be found on some of his own, or some of the other numerous excursions sent annually to this excellent field by the university.

The nests are built high up in the cliffs, in the most inaccessible places. The semi-lithified sandstone of these buttes is easily excavated; and, as nearly as could be learned, the swifts dig back about eighteen inches, the opening barely admitting the hand but expanding somewhat at the nest. The nests are built of grass.

As their early name implies, these swifts are all wings; accordingly the swiftness of their flight is such that the best shots make many misses and few hits. It took several rounds of ammunition for the five just added to the State collections. These specimens are all males, and inasmuch as their measurments differ slightly from published measurements, i. e., length 6.50–7.00 inches; extent, 14.00; they are given below for each bird:—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Length,	$6\frac{1}{4}$	$6\frac{3}{8}$	$6\frac{1}{4}$	$6\frac{3}{8}$	$6\frac{1}{4}$
Expanse,	14	$14\frac{1}{4}$	$14\frac{1}{4}$	$14\frac{3}{8}$	14

From the foregoing measurements it will be seen that, while the length is less, the expanse is greater than those published. These swifts were first observed by Professor Bruner while on a government entomological expedition in the summer of 1891. At the direction of Professor Bruner his ornithological assistant, Mr. J. B. White, shot and prepared the above specimens this past summer. Being in charge of the Morrill geological expedition sent to this region by the University, I had occasion to fall in with Professor Bruner's party, and to observe these swifts personally. We must have seen several hundred at Squaw Canon flying in and out among the buttes which rise with nearly vertical walls five hundred to twelve hundred feet above the Hot Creek Basin.

Having occasion to visit this region several times annually with parties of students, it is to be hoped that we may obtain data for further notes, and that it may be possible to secure their nests and eggs, in spite of their inaccessible abodes.

Erwin H. Barbour.

University of Nebraska, Sept. 30.

Star 1830 Groombridge.

In *Science* for Sept. 30, I note the letter of Professor A. W. Williamson, in which he propounds an hypothesis, admitted by himself to be forced and unwarranted by any natural facts, to account for the incredible velocity attributed to the Star 1830 of Groombridge's catalogue. It is not necessary to resort to such untenable speculations to explain the phenomena referred to. The only reason for assigning such an extreme velocity to the star in question is the fact that it exhibits quite a large proper motion and no appreciable parallax. It may be, however, merely a case of masked parallax. If we suppose the star to have a large dark companion (numerous instances of which are known, as Algol, Procyon, etc.), we only need to assign to it a period and radius of revolution closely approximating that of the earth in its orbit, and a favorable position of orbital plane, to render the parallax quite imperceptible by the old methods. In such case the spectroscope might solve the problem by determining the orbital velocity, and thence the other elements, in case the plane of the orbit lay in our direction, and thus show that this star is really one of the nearest in the heavens to our system.

Henry H. Bates.

Washington, D.C., Oct. 5.

Dr. Brendel's Photographs of Auroras.

In your issue of July 22, 1892, you copied from *The Scottish Geographical Magazine* an interesting notice of the expedition made by Dr. Martin Brendel and Herr O. Baschin to Bossekop on the northern coast of Norway, last winter, to study the northern lights and attendant phenomena. Therein mention was made of the photographs of the aurora obtained by Dr. Brendel.

By his courtesy copies of some of these pictures are before me. Dr. Brendel modestly regards them as valuable chiefly for what they promise for the future. He hopes to visit the Arctic regions again with a much better equipment. But he has already achieved a great feat in securing even these photographs, the first of the kind ever taken. Tromholt's attempt in 1885 cannot be regarded as a success. The faintness of the light, the quivering and shifting of the auroral rays, and the non-actinic quality of certain colors, combine to make this a very difficult task. Dr. Brendel

does not say who manufactured the plates which he used; but they measure four by five inches. With a steady, diffused glow on an arch he has had very fair success, with an exposure of between forty seconds and five minutes. With a greatly agitated, curtain-like display, and an exposure of only one minute, he lost all detail. But a very sharp picture was secured, with an exposure of six seconds, of one end of an arch, which was composed of radiant streamers; the structure is distinctly shown. The pictures were obtained between Jan. 4 and Feb. 1, this year. On the night of Feb. 13-14, a heavy snow-storm prevented observations of the famous aurora of that date; but, as has already been mentioned, a remarkable magnetic disturbance was recorded by the needles.

The scientific world will wish Dr. Brendel good luck in his future endeavors, and will watch eagerly to see whether he finds it practicable to determine the parallax of auroras by this method.

JAMES P. HALL.

Brooklyn, N.Y., Oct. 8.

BOOK-REVIEWS.

The Horse: A Study in Natural History. By WILLIAM H. FLOWER, Director of the British Natural History Museum. New York, D. Appleton & Company.

THE "Modern Science Series," edited by the distinguished scientist, Sir John Lubbock, is not primarily designed for the specialist, nor, on the other hand, for the class of readers that reads merely to be entertained. It attempts rather to supply accurately, yet in language divested of needless technicalities, such information as is needed by everyone who desires to keep fairly abreast of the progress of modern knowledge.

The name of the author of the present volume is in itself a guarantee of the accuracy and interest of its contents, and in the reading we are not disappointed; for within 204 short pages the horse and its relations to nature are presented in a sketch which is at once attractive and thorough.

In the first chapter the ancestral relations of the horse are especially considered; the second chapter discusses chiefly the horse's living allies; while the third and fourth chapters are devoted to structural features. But what adds unusual interest to the book is that the bearing of the facts upon the origin of the horse is in every chapter constantly kept in view. "The anatomy and history of the horse are . . . often taken as affording a test case of the value of the theory of evolution, or, at all events, of the doctrine that animal forms have been transmuted or modified one from another with the advance of time, whether, as extreme evolutionists hold, by a spontaneous or inherent evolving or unrolling process, or, as many others are disposed to think, by some mysterious and supernatural guidance along certain definite lines of change."

The conclusion is forced home to the reader that the horse is a very highly specialized type derived from a generalized ancestor by slow and gradual change, or evolution. The one-toed animal was once five-toed, and its heel was less raised above the ground than now; its teeth were once fitted for a much wider range of diet; its neck was short and a collar-bone, now absent, was once present; its tail was long; its brain — and especially the cerebrum — was small; instead of the open plain, it frequented the shady or often marshy borders of lakes and streams.

The various pages in the history of this evolution are presented as they have been recorded in the book of nature till at last the genealogy is traced back to the five-toed and otherwise generalized type, *Phenacodus*,, of early Eocene age.

The work is illustrated with twenty-seven clear, well-selected cuts, of which that of the quagga deserves especial notice as being from the first photograph known to have been taken from the living animal.

The external appearance of the book is unusually attractive.